REMARKS

Claim Rejections

Claims 2, 4, 8 and 10 are pending in the application.

Claims 4, 8 and 10 are withdrawn.

Claim 2 is rejected.

35 U.S.C. § 103 rejection

Claim 2 is rejected under 35 U.S.C. § 103 (a) as being unpatentable over Bayon et al. in view of by Nakada et al.

Claim 2 is amended to clearly distinguish the present invention from the cited references Bayon and Nakada. Support for the amendment is found in the specification at least in paragraphs [0018]-[0020] of the US Patent application publication.

According to the present invention, a light absorbing layer is provided with an InS-buffer layer formed thereon by depositing particles of n-type semiconductor material, which layer is featured by gradually or stepwise increasing grain size of deposited particles in the direction departing from the surface of the light absorbing layer. In particular, the buffer layer of n-type semiconductor material is rich in InS in the direction to the CIGS light-absorbing layer side and rich in InOH-InO in the direction toward a transparent electrode side.

The buffer layer provides the following optimum interfacial conditions between the light absorbing layer and the buffer layer as well as the buffer layer and the transparent electrode:

An In_2S_3-rich layer formed by regulating pH of the aqueous solution of the chemical bath to an acidic value can effectively cover the top surface of the light-absorbing layer 5, achieving the junction best suited to the latter layer.

To prevent plasma damage from reaching the junction surface with the buffer layer 6, it is necessary to increase the thickness of the buffer layer 6. However, it is disadvantageous to increase the thickness of the InS-rich deposition in the buffer layer because InS has a small band

gap and may reduce the optical transmittance of the buffer layer. On the contrary, the layer rich in $In(OH)3 \bullet In_2S_3$, which is formed by regulating the pH of the solution to an alkaline value, has a larger band gap and can serve as a transparent electro-conductive layer. Therefore, it is desirable to from a thicker upper-side deposition being rich in $In(OH)3 \bullet In_2S_3$ in the buffer layer which can be free from the effects of plasma damage in the process of forming a transparent electrode 7 and can attain suitable conformity with the transparent electrode 7 without reducing the optical transmittance of the buffer layer. The above-described three processing steps can form the buffer layer on the light-absorbing layer, which possess a distribution of InS particles continuously changing in grain size from small to larger, achieving tight adhesion to the rough surface of the CIGS light absorbing layer with an increased coverage.

It has been considered that the use of the InS layer in a solar cell is disadvantageous since InS has a small band gap, making it hard to pass light of short wavelengths. The above disadvantage has now been eliminated by the method according to the present invention: Namely, the method can produce the light absorbing layer with the InS buffer layer which has an increased light transmittance and improved adhesion to the light absorbing layer and suitable conformity with the transparent electrode.

Both Bayon and Nakada fail to describe the forming of a buffer layer comprising lower side deposition of particles being rich in InS and smaller in grain size toward the light-absorbing layer side and the upper side deposition of particles being stepwise larger in grain size and being rich in InOH•InO toward the transparent electrode side.

Bayon merely monitors the grain size of particles. He is silent on the technical features of the buffer layer having a lower side deposition of particles being smaller in grain size and being rich in InS toward the light-absorbing layer side to attain the tight adhesion to the top surface of the light-absorbing layer and an upper side deposition of particles being gradually larger in grain size and rich in InOH•InO toward the transparent electrode side attaining an improved light transmittance even with an increased deposition layer thickness. Thus, the buffer layer of InS formed by the method according to the present invention can possess the high optical transmittance, increased tightness of adhesion to the top surface of the light-absorbing layer and improved conformity with the transparent electrode, namely, by using a unique layer

forming process, overcoming the disadvantage of using the InS material that has a small band gap, making it hard to pass short wavelength light. The above mentioned technical features of the present invention are not disclosed or suggested by the Bayon reference.

Nakada describes the process featured by repeatedly increasing the temperature from room temperature in the process of forming a thicker buffer layer. Therefore, it is apparent from the above that Nakada give no consideration to obtaining a buffer layer having a high optical transmittance, tight adhesion to the light-absorbing layer and suitable conformity with the transparent electrode even by using InS material having a small band gap and being hard to pass light of short wavelengths. Therefore, the method of the present invention of forming the buffer layer having optimum interfacial conditions both with the light-absorbing layer and the transparent electrode could not be percieved by the combination of teachings of the cited references.

Applicant therefore respectfully submits that claim 2 is patentable over Bayon in view of Nakada, and requests reconsideration and withdrawal of the rejection.

CONCLUSION

In light of the above discussion and amendment, it is believed that the remaining pending claim is in a condition for allowance and a notice of the same is requested. Should the Examiner have any questions, requests or suggestions, the Examiner is invited to contact the undersigned at the telephone number indicated below.

No fee is believed due with this submission. However, The Commissioner is hereby authorized during prosecution of this application to charge any fees that may be required (except for patent issue fees required under 37 CFR §1.18) or to credit any overpayment of fees to Deposit Account No. 50-0337. If an extension of time is required in connection with this paper, please consider this a Petition therefore and charge any fees required to Deposit Account No. 50-0337.

Dated: June 8, 2010

Respectfully submitted,

/Jeffrey S. Schoenwald/
Jeffrey S. Schoenwald
Agent for Applicant
Reg. No. 60,602

FULBRIGHT & JAWORSKI L.L.P
555 South Flower Street , 41st Floor
Los Angeles, CA 90071
(213) 892-9200 – Telephone
(213) 892-9494 – Facsimile

cc: G. Wood